Accordingly, another aspect of the present invention is a method of treating an individual suffering from a disease associated with hyperproliferating cells, which comprises the step of administering to said individual an amount of WNV or other viruses including *Flavivirus* or *Pestivirus* capsid protein, or functional fragment thereof, and/or a nucleic acid molecule encoding WNV or other viruses including *Flavivirus* or *Pestivirus* capsid protein, or a functional fragment thereof, sufficient to induce the apoptosis of said cells.

Another aspect of the present invention is a method of treating an individual suffering from a disease associated by undesirable cells such as autoimmune diseases, which comprises the step of administering to said individual an amount of WNV or other viruses including *Flavivirus* or *Pestivirus* capsid protein, or functional fragment thereof, and/or a nucleic acid molecule encoding WNV or other viruses including *Flavivirus* or *Pestivirus* capsid protein, or a functional fragment thereof, sufficient to induce the apoptosis of said cells.

Another aspect of the present invention relates to vaccine compositions that comprise WNV or other viruses including *Flavivirus* or *Pestivirus* capsid protein, or an immunogenic fragment thereof, and/or a nucleic acid molecule encoding WNV or other viruses including *Flavivirus* or *Pestivirus* capsid protein, or an immunogenic fragment thereof, and a pharmaceutically acceptable carrier or diluent. Vaccine compositions comprising capsid protein from WNV or a other viruses including *Flavivirus* or *Pestivirus*, or an immunogenic fragment thereof, are useful for immunizing an individual against WNV or a other viruses including *Flavivirus* or *Pestivirus*. The immunity may be prophylactic (to prevent infection) or therapeutic (to treat infection). Where the immunity is prophylactic, the individual is protected against challenge with the virus. Where the immunity is therapeutic, the individual's current viral infection is treated.

Accordingly, an aspect of the present invention is a method of treating an individual suffering from WNV or a other viruses including *Flavivirus* or *Pestivirus* infection, which comprises the step of administering to said individual an amount of capsid protein, or an immunogenic fragment thereof, from WNV or a other viruses including *Flavivirus* or *Pestivirus*, sufficient to stimulate a therapeutic immune response.

Another aspect of the present invention is a method of preventing WNV or a other viruses including *Flavivirus* or *Pestivirus* infection in an individual, which comprises the step of administering to said individual an amount of capsid protein, or an immunogenic fragment

thereof, from WNV or a other viruses including *Flavivirus* or *Pestivirus*, sufficient to stimulate a prophylactic immune response.

When capsid protein, or an immunogenic fragment thereof, from WNV or other viruses including *Flavivirus* or *Pestivirus*, is delivered to an individual as a component in a vaccine (either directly as protein or by subsequent expression from a nucleic acid delivered in the vaccine), the capsid protein, or immunogenic fragment thereof, becomes a target against which the individual develops an immune response, protecting from infection (prophylactic), or treating an infection (therapeutic). Those of skill in the art will recognize that the immune response can be both therapeutic and prophylactic, in that following a therapeutic treatment, the individual may be protected from further challenge with the virus.

Capsid protein

WNV capsid protein, or functional fragments thereof, may be produced by routine means using readily available starting materials as described above. The nucleic acid sequence encoding WNV capsid protein as well as the amino acid sequence of the protein are well known. The entire genome for a number of WNV isolates are published and available in GenBank, including isolate 2741 (accession number AF206518), strain NY99-flamingo382-99 (accession number AF196835), the complete polyprotein gene of strain HNY1999 (accession number AF202541) and the isolate identified as accession number M12294, each of which is incorporated herein by reference. There are a variety of publications relating to sequence information for the WNV genome, citations of which are linked to the sequence information in GenBank. Each of these references, including the publicly available sequence information, is incorporated herein by reference.

Sequence information for capsid proteins and nucleic acids from other *Flaviviruses* or *Pestiviruses* can also be found in GenBank. By way of non-limiting examples, complete genome sequences of strains and isolates provided in GenBank include, JEV (accession number M18370, D90194, and D90195), SLEV (accession number M16614), YFV (accession numbers AF094612, U17067, U17066, U54798, U21055, U21056, and X03700), DENV (accession numbers M23027, U88535, U88536, and U88537), and BVDV (accession number M31182), each of which is incorporated herein by reference.

Provision of a suitable DNA sequence encoding a desired protein permits the production of the protein using recombinant techniques now known in the art. The coding sequence can be

obtained by, for example, cloning it from infected cells, using PCR primers designed based upon the publicly available sequence information. The DNA sequence may also be prepared chemically using a DNA synthesizer. When the coding DNA is prepared synthetically, advantage can be taken of known codon preferences of the intended host where the DNA is to be expressed. Additionally, changes may be introduced into the coding sequence, such as point mutations, insertions, or deletions, to create controls and other modified forms of the capsid protein.

One having ordinary skill in the art can, using well known techniques, obtain a DNA molecule encoding the WNV capsid protein or a other viruses including *Flavivirus* or *Pestivirus* capsid protein and insert that DNA molecule into a commercially available expression vector for use in well known expression systems. For example, the commercially available plasmid pSE420 (Invitrogen, San Diego, CA) may be used for capsid protein production in *E. coli* bacteria cells. The commercially available plasmid pYES2 (Invitrogen, San Diego, CA) may be used for production in yeast cells, such as *S. cerevisiae*. The commercially available MaxBac 2.0 Kit (Invitrogen, San Diego, CA), with the pBlueBac4 vector, is a complete baculovirus expression system that may be used for the production of capsid protein in insect cells, such as Sf9 cells. The commercially available plasmid pcDNA I (Invitrogen, San Diego, CA) may be used for the production of capsid protein in mammalian cells, such as Chinese hamster ovary cells.

One having ordinary skill in the art can use these commercial expression vectors systems or others to produce WNV and other viruses including *Flavivirus* or *Pestivirus* capsid proteins using routine techniques and readily available starting materials.

One having ordinary skill in the art may use other commercially available expression vectors and systems or produce vectors using well known methods and readily available starting materials. Expression systems containing the requisite control sequences, such as promoters and polyadenylation signals, and preferably enhancers, are readily available and known in the art for a variety of hosts. *See, e.g.*, Ausubel *et al.*, eds., Current Protocols in Molecular Biology, *supra.* Thus, the desired proteins can be prepared in both prokaryotic and eukaryotic systems, resulting in a spectrum of processed forms of the protein.

The most commonly used prokaryotic system remains *E. coli*, although other systems such as *Bacillus subtilis* and *Pseudomonas* are also useful. Suitable control sequences for prokaryotic systems include both constitutive and inducible promoters including, but not limited